REMARKS

Applicants note with appreciation the indication by the Examiner that Claims 22, 29, 31-36 and 38 recite allowable subject matter. The foregoing amendment amends Claims 20, 23 and 27, and cancels Claim 24. Now in the application are Claims 18-23 and 25-38 of which, Claims 18, 23, 25, 26 and 27 are independent. No new matter has been added and no new issues are raised.

Claim Amendments

Claims 20 and 23 are amended to address the rejection under 35 U.S.C. §112, first paragraph.

Claim 27 is amended to clarify the monitored flow is a multiple phase fluid flow.

Claim Rejections under 35 U.S.C. § 112

Claims 20, 23 and 24 stand rejected under 35 U.S.C. §112, first paragraph for failing to comply with the written description. More specifically, the Office Action rejects these claims for containing new matter. In response, Applicants have amended Claims 20 and 23 and canceled Claim 24.

Applicants consider the rejection of Claim 24 moot in view of the foregoing amendments.

Claim 20 is amended to replace "stored in a computer memory" with "recorded." Support for the amendment can be found in paragraph 82 of the specification. No new matter is added. Accordingly, Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claim 20 under 35 U.S.C. §112, first paragraph.

Claim 23 is amended to replace "further comprising a computer processor and a computer memory containing" with "calibrated with." Support for the amendment can be found in paragraphs 66 and 67 of the specification. No new matter is added. Accordingly,

Applicants respectfully request the Examiner to reconsider and withdraw the rejection of Claim 23 under 35 U.S.C. §112, first paragraph.

Claim Rejections under 35 U.S.C. § 102

Claims 18, 19, 23-28, 30 and 37 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,095,760 to Lew (hereinafter "Lew"). Applicants respectfully traverse the rejections and contend the claims are patentable based on the following arguments.

The Lew patent is directed to a vortex shedding flowmeter that includes a vortex sensor detecting lift force generated by vortices shed from the vortex generator and experienced thereby, and a noise sensor detecting mechanical vibrations experienced commonly thereby and by the vortex sensor. The Lew patent does not does not anticipate Claims 18, 19, 23-28, 30 and 37.

In the Office Action it is acknowledged that the Lew patent does not expressly disclose a two or three phase fluid flow as recited in Claims 18, 19, 23-28, 30 and 37. However, the Office Action goes on to state that the measurement or detection of a two or three phase fluid flow with a vortex flowmeter is inherent, because vortex flowmeters are known to be suitably adapted for the measurement of two-phase fluid flows. Applicants respectfully disagree with the inherency reasoning expressed in the Office Action.

Vortex flowmeters are normally used to determine the volumetric flow rate of a fluid. The vortex shedding frequency is directly proportional to this volumetric flow rate and is directly measurable. However, the volumetric flow rate (e.g. litres per minute) is not the same as the mass flow rate (e.g. kg per minute). Mass equals volume times density (M=V x D), so that knowledge of the density is essential to obtain mass flow rate from volumetric flow rate.

If the fluid is a liquid, since most liquids are virtually incompressible, the density is virtually independent of pressure, and only varies by a small amount with temperature, due to thermal expansion of the liquid. Hence, mass flow rate for a liquid can be accurately determined

using a vortex meter by scaling the volumetric flow rate reading by a fixed value for density, independent of pressure.

However, for gaseous fluids, the density varies strongly with pressure (e.g. density is proportional to T/P for an ideal gas, where T is absolute temperature, and P is absolute pressure). For a non-ideal gas the relationship between density, temperature and pressure can be very complex. Hence, it is necessary to measure density to accurately convert volumetric flow rate to mass flow rate.

The Lew patent describes a method of measuring the mass flow rate of a single fluid i.e. it applies only to single-phase fluid flow. Lew does this by combining (1) the vortex shedding frequency, which yields the volumetric flow rate of the fluid with (2) the amplitude of the vortex oscillations, which depends on the density of the fluid, so that the fluid density and subsequently the mass flow rate may be deduced.

For single-phase fluid flow, the amplitude A of the vortex signal oscillation is given by $A = K.\rho.Q^2$, where K is a constant, r is the fluid density, and Q^2 is the square of the volumetric flow rate Q.

If a second phase component is present the amplitude A of the vortex oscillation signal changes and is strongly affected by the fraction of second phase present, and the amplitude varies in a manner quite differently from its behavior with single-phase flow, meaning that this equation is no longer valid. This may be seen by the following example.

By experiment, adding 5 litres/min airflow to 200 litres/min water flow reduces the RMS amplitude A of the vortex shedding signal by 21.5%. Since the total volumetric flow rate increases from 200 litres/min to 205 litres/min, the shedding frequency increases by 205/200 i.e. 2.5% as would be expected. The volumetric flow change increases Q^2 by $(205/200)^2 = 1.05$ i.e. by 5%. Hence, using the relation density $\rho = A / (K.Q2)$ from above, the decrease in the oscillation amplitude A of 21.5% together with the increase in Q^2 of 5% would suggest a reduction in density ρ by 1.215 * 1.05 = 1.275 i.e. 27.5%. In fact the density of the two-phase

mixture has decreased by only 2.5%. Thus the relation between vortex shedding amplitude A and density r for two-phase flows does not obey the simple relation $A = K.\ \rho.Q^2$.

Hence the method taught by Lew will only work for single-phase flow regimes, where only one fluid phase component is present. Nowhere in the Lew patent is it suggested that the disclosed method is applicable to two-phase flow, because it isn't. The Lew method does not aim or demonstrate how to measure two-phase flows, or even how to correct for the increase in shedding frequency that occurs when an additional second fluid phase component is present. This increase in shedding frequency must be compensated for to avoid an error in the reading in the flow rate of the first phase component, and requires knowledge of the amount of flow of the second phase. Hence, Applicants respectfully contend that the Lew patent does not anticipate Claims 18, 19, 23-28, 30 and 37.

CONCLUSION

In view of the above arguments, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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